MetroEdge-Express

H9MO-LMX/LM

SDH Fiber-Optic Access Platform

User Manual

Beijing Huhuan Electronics Co., Ltd.

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1. 🕮 Introduction

Thank you for selecting MetroEdge-Express, the SDH based fiber optic multi-service access platform.

The MetroEdge-Express is built on SDH/MSPP technology. It is aimed at providing both TDM based traditional telecom services and ever growing Ethernet based data services. There are two types of equipment in the MetroEdge-Express family, the CPE end equipment (hereafter referred to as LM, LMSUB, and LMFIT), and the aggregation equipment at the central office (hereafter LMX).

1.1 CPE Equipment

There are three types of CPE equipment in MetroEdge-Express. The basic model is H9MO-LM, and a more flexible version is H9MO-LMFIT. The LM is designed for point-to-point applications, while the LMFIT can also operate in ADM mode for more complicated topologies such as rings and chains. Both LM and LMFIT operate at STM-1 SDH line rate. A lower line rate version is called LMSUB which operates at sub-STM-0. Table 1-1 lists main features of each type of the CPE equipment.

Table 1-1 Difference between CPE models

Model	Feature
LM	4×E1@TU-12-1~TU-12-4; FE@TU-12-5~TU-12-63(non-virtual concatenated);
LMFIT	4 interface slots, multi-interface card selections include: 4×E1card, full speed FE card, FE over N×VC-12 virtual connection (N≤8), n×64kbps V.35 card, fiber optic interface card.
LMSUB	4×E1@TU-12-1~TU-12-4, sub-STM-0 FO interface

Other features common to all models:

- Standard STM-1 FO interface (except LMSUB), FO interface options include 1+1 protection, dual or single fiber transmission, 1310 or 1550 wavelengths, different optical power budget.
- Standard 19 inch 1 unit high box. Half-width option available for LM and LMSUB.
- 48V DC or 220V AC power supply.

1.2 Aggregate Equipment

The multi-slot aggregate equipment H9MO-LMX can hold up to 16 tributary cards(LIU's), and up to 2 network interface cards(NIU's). Different LIU cards are available as listed in Table 4-1. By selecting appropriate LIU's, the tributary slots can provide different interfaces to meet the application requirements. The most common LIU is the OFE card, which is an STM-1 fiber optic line card with a FE port. It is mainly used to connect to the CPE equipment H9MO-LM. Other LIU's include E1 interface card, V.35 interface card,

FE over virtual concatenated VC-12 card, etc. The NIU cards provide connection to the SDH core network through FO or coax cable STM-1 interfaces. The built-in cross-connect matrix grooms all the VC-12 from all the tributary LIU's into the upstream STM-1. The maximum cross connect capacity for each LIU is 16 VC-12's.

The 2 upstream NIU's can either carry a total of 126 unprotected VC-12 channels, or it can provide Sub-Network Connection Protection for selected VC-12 channels. When all channels are protected, the maximum upstream capacity is 63 VC-12s.

The LIU OFE at the LMX establishes E1 channels and a full speed fast Ethernet connection between LM and LMX to provide both E1 and data services to the customer. While the E1 stream is loaded into VC-12 containers and aggregated into the upstream STM-1 for transmission across the SDH network, the Ethernet is terminated at the LMX for connecting to the data network. For applications where an Ethernet channel is to be established across the SDH network, LMFIT with an Ethernet over virtual concatenated VC-12 interface card should be used.

In addition to STM-1 framing and multiplexing, the NIU card also integrates other SDH equipment functions, including a built-in TUPP (tributary unit pointer processor), a 382×382 TU-12 cross-connect matrix, a G.813 SDH equipment clock unit, the orderwire telephone subsystem, and the microcontroller unit for network management.

The orderwire subsystem allows an operator at the LMX to dial a LM. One can also initiate a call at the LM side by pushing a hotline button.

The management of LMX is based on the SNMP protocol, through a 10Base-T management port. A RS232 console port is also available for command line operation on the equipment.

For maximum operational availability, the LMX has a set of redundancy options, such as 1+1 power cards, dual -48V DC power supply ports, NIU 1+1 protection, etc. All cards are hot-plug protected.

The aluminum chassis of LMX is of 7-unit high and standard 19-inch wide. The 16 half height LIU cards can provide independent CPE connections in the case of STM-1, or each card may connect to 2 LMSUB where the line rate is sub-STM-0.

The chassis is designed in Dual Front concept, that is, either side can be used as the front panel. If you prefer front connections, the card insertion side can be made front. In this way, all the cables are accessed in the front, and LED's on each card provide operation status indication. But if you prefer rear cable access, then the back plane side with a big plate can be made front. In order to provide operation status indication, a LCD display screen is provided on this side. The orderwire telephone keyboard can be used as the hand held terminal for command input.

2. 🕮 Typical Application

Fig. 2-1 depicts a typical application scenario of the MetroEdge-Express. In the diagram, each H9MO-LMX at the central office is connected to a set of H9MO-LMs at the remote sites, providing E1 and FE interfaces to the customers.

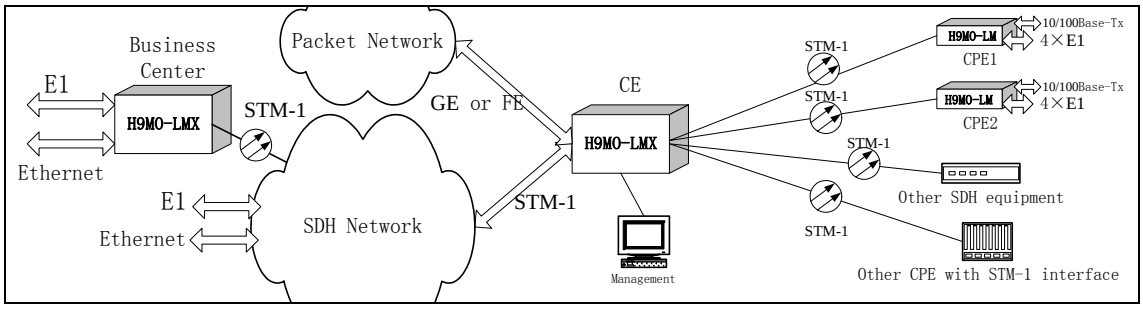


Fig. 2-1 MetroEdge-Express used in star topology

Since the fiber optic interface of the LMX LIU is SDH, it can connect to any third party equipment other than LM, such as the remote module of switch equipment etc., as long as it has a standard STM-1 port, as depicted in the diagram.

The E1 traffic from the CPE's are aggregated into the upstream STM-1, and carried over the SDH network to the business center or anywhere on the network. The Ethernet traffic is sent over the public packet network, or it may also be carried by the SDH network using EoS technology.

At the business center, such as the customer's headquarter, the LMX is configured as a channel bank, providing multiple E1 and Ethernet access to the SDH network through STM-1 links.

Compared with traditional PDH access platforms, the MetroEdge-Express connects to the core network through STM-1 links rather than multiple E1 cables. This translates to substantial savings on the number of E1 cards, cables, DDF racks, as well as floor space. On the access line side, the standard STM-1 interface makes it possible for any CPE equipment with a STM-1 port to be connected to the MetroEdge-Express directly, instead of through stand alone fiber optic modems. For CPE's with Ethernet or V.35 ports, direct mapping of these data streams into VC-12 containers eliminates the need for additional converters. All these advantages reduce CPEX for the operators.

OPEX is also lowered with the MetroEdge-Express. The elimination of multiple E1 cables and converters in between, simplifies the installation, provision, and maintenance. Fewer connections also help to reduce the fault probability, increase quality of service levels. Manual rearrangement of E1 connections on the DDF are replaced by mouse clicks and drags on the virtual DDF on the computer screen. The standard STM-1 format on the access link means that the optical signal can be monitored or analyzed with off-the-shelf SDH testers. In contrast, PDH optical interface is not standardized, and no testers other than power meter can be used for trouble shooting a PDH fiber optic link.

The two NIU cards can be arranged to make two connections to the core network, providing sub network connection protection for selected channels, as shown in Fig. 2-2.

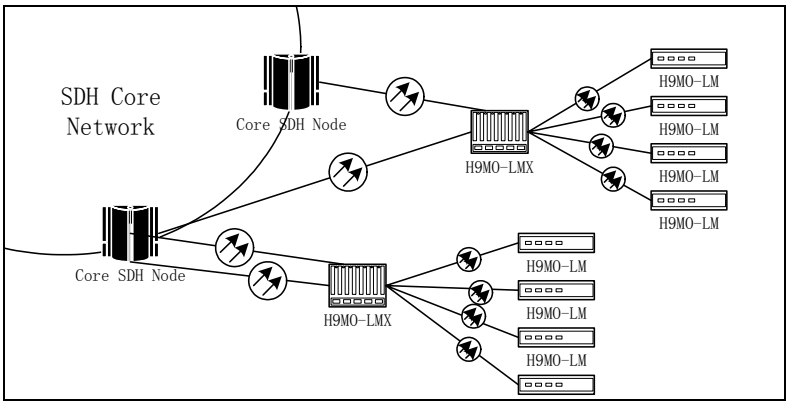


Fig. 2-2 Up-stream Protection

In Fig. 2-2, both LMX's are connected to the core SDH network with dual STM-1 links. Traffic is protected by traveling through different fiber optic links and different NIU cards. The upper LMX connects to different core SDH nodes rather than to two STM-1 cards on the same node. This is a better protection scheme as it not only protects against fiber cuts and card failures, but also protects against core node failures. The protection is based on VC-12 sub network connections. It can either be applied to all the VC-12 traffic, or to selected VC-12 channels, give extra unprotected capacity.

NIU cards on a LMX can also work in ADM mode to form a SDH ring, as shown in Fig. 2-3.

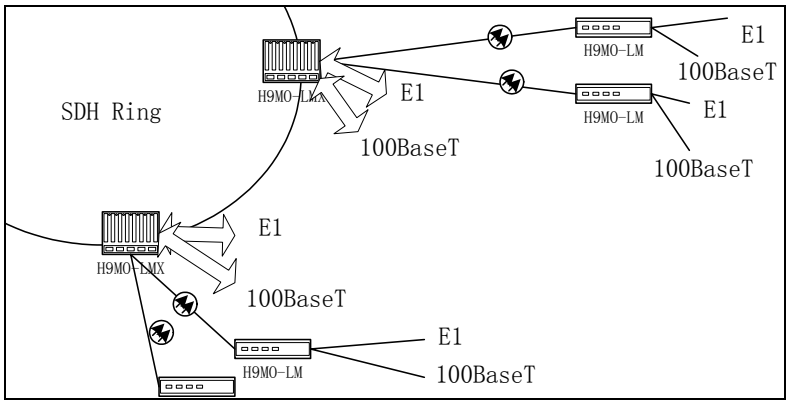


Fig. 2-3 Ring topology

The H9MO-LM can also be used in a point-to-point fashion like its PDH counterparts. It can provide not only 4 E1 channels but also a full speed 100Base-T Ethernet link between two end points, as shown in Fig. 2-4. Since the H9MO-LM is a standard SDH box, it can also be used to set up a point-to-point link across a SDH network in which a VC-4 is allocated for this purpose. This is another advantage over PDH units.

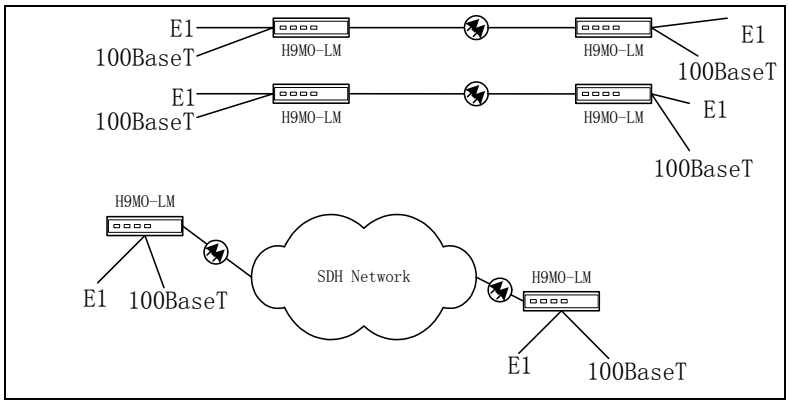


Fig. 2-4 Point-to-point links

3. 🕮 H9MO-LM

This chapter describes the basic CPE model, the H9MO-LM. The more flexible H9MO-LMFIT is described in a separate manual.

3.1 Function Blocks

The internal block diagram of the LM is shown in Fig. 3-1.

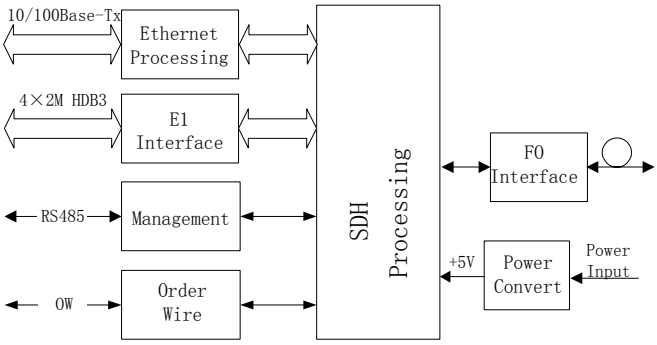


Fig. 3-1 Functional Block Diagram

The core of a LM unit is the SDH processing block implemented in a single FPGA. Its functions include SDH mapping, pointer processing, multiplexing, framing, clock extraction, alarm detections.

The Ethernet processing deals with the Ethernet interface functions, such as rate negotiation, CRC processing etc. The E1 interface block converts between TTL level and HDB3 signal format. FO interface converts STM-1 optical signal into electrical format for processing by the FPGA, and vice versa. Orderwire block allows maintenance telephone conversation to be established between two connected LM units, or between the LM and

the LMX. A handset is used for orderwire instead of a full functional telephone set.

As a CPE equipment, management on LM is usually done through the management station connected to the LMX. When used in a point-to-point link, management is through the RS485 management port using TABS protocol.

The power conversion block converts input -48V DC or 220V AC power supply to internal voltages for logical operations.

3.2 Front Panel

The front panel of a LM is shown in Fig. 3-2. On the front panel, there are alarm and status indication LED's, mode switches, fiber optic interfaces, the OW jack and call button, etc. This section explains them in detail. Note that the actual panel differs with different options, especially the choice of FO interface modules.

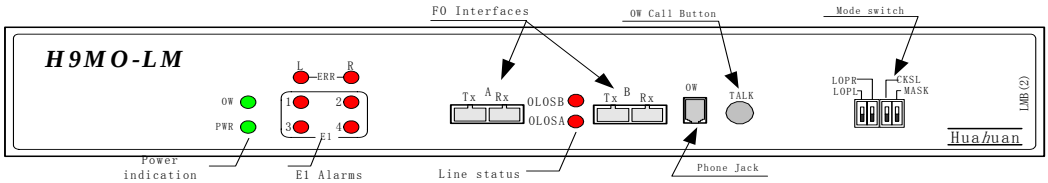


Fig. 3-2 LM Front Panel

The LED's:

The LED's on the front panel indicates the operation status and alarms of the LM unit. They are listed in Table 3-1.

Table 3-1 LED's on H9MO-LM

Notation	Color	Description	Note
PWR	G	5V Power indication.	
OW	G	Orderwire telephone call indication.	
ERR-L ERR-R	R	Local (L) and remote (R) receive bit error indication. On: Severe bit error on fiber link Wink: sporadic bit error on fiber link Off: no received bit error	
E1-n (n=1,2,3,4)	R	nth E1 port condition indication On: loss of incoming HDB3 signal(LOS) Fast wink(~0.5s): AIS or HDB3 code violation Slow wink(~1s): the port is in loop-back mode Off: normal operation or alarm masked	

Notation	Color	Description	Note
OLOS OLOSA OLOSB	R	Optical line status On: Loss of incoming optical signal Wink: Loss of frame Off: Normal	OLOS for single port option，OLOSA and OLOSB for 1+1 protection option
ETH-L	G	Ethernet link indication	On the rear panel at the RJ45 jack
ETH-F	Y	Ethernet duplex mode On: Full duplex Off: Half duplex Wink: Collision	

FO Interface:

Default fiber optic interface is the dual fiber SC socket type, with nominal wavelength of 1310nm and link range of under 40km. Tx denotes output port, and Rx the input port. With single fiber option, only one fiber socket is used for both input and output. Single fiber module transmits and receives optical signals in different wavelengths. Only transmit wavelength is specified. Usually, the single fiber version LIU on LMX transmits at 1310nm, and single fiber LM transmits at 1550nm. Note that when two single fiber LM's are to be linked point-to-point, they must have different transmit wavelength.

Orderwire:

The phone jack on the front panel can be connected to a 4-wire handset. Note that telephone handset pin-out may differ for different manufacturers. The pin-out on the LM is given in Table 3-2. Handsets with a different pin arrangement will not work.

Table 3-2 OW socket pin arrangement

Pin No.	1	2	3	4
definition	Rx-	Tx+	Tx-	Rx+

Note: the R+ and R- is connected to the microphone in the handset, and the T+ and T- is connected to the earphone in the handset.

The TALK push button acts as the telephone hook. Push down the button generates off-hook signal and rings the remote to initiate the call. It is also used to receive a call.

The Dip Switches:

There are 4 dip switches on the right of the front panel. They are used to control the operation mode of the LM. Table 3-3 explains their functions.

Table 3-3 The dip switches

Dip No	Label	Description
1	LOPL	Downward flip will issue the local loop-back command, making all 4 E1 ports on the local unit performing Rx to Tx loop-back. Upward flip cancels the local loop-back.
2	LOPR	Downward flip will issue the remote loop-back command, making all 4 E1 ports on the remote unit performing Tx to Rx loop-back. Upward flip cancels the remote loop-back.
3	CKSL	Clock mode selection. Upper position selects internal oscillator, and down position selects line clock mode.
4	MASK	Downward flip masks out all current E1 alarms.

Note: a) Loop-back commands can also be issued through management software. The last command takes effect.

b) When connected with LMX, the standard clock mode for LM is line clock, i.e., the LM is synchronized to the incoming STM-1 clock. But when paired in a point-to-point link, at least one of the LM should be set to internal clock mode.

c) The LOPL and LOPR are indicated in Fig. 3-3.

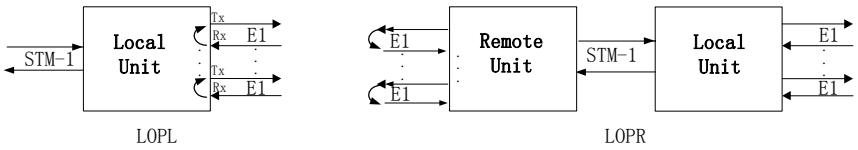


Fig. 3-3 Local and remote loop-backs

3.3 Rear Panel

Fig. 3-4 shows the rear panel of a LM unit.

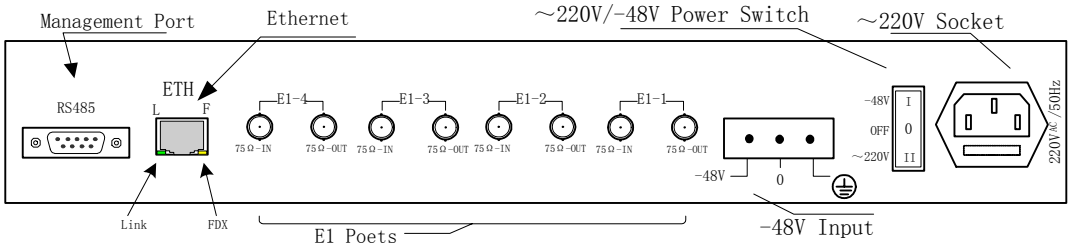


Fig. 3-4 LM Rear Panel

E1 Port:

E1 port-1 to port-4 are aligned left to right. Default E1 ports use 75Ω BNC coaxial connectors, IN and OUT denote input and output ports respectively. Optionally, 120Ω version with RJ48 ports is also available.

Ethernet Port:

The RJ45 connector on the left of the rear panel is the Ethernet port. There are 2 LED's on the RJ45 jack, marked ETH-L and ETH-F. They are link and full duplex indicators as described in Table 3-1. The pin-out of the RJ45 port is given in Table 3-4.

Table 3-4 RJ45 Pin Out

Pin	1	2	3	4	5	6	7	8
Sig.	TxD+	TxD-	RxD+			RxD-		

Note: The port is HP auto-MDIX compliant, it will automatically adapt to MDI or MDI-X interfaces. That is, either parallel or crossover cables can be used to connect to any 10/100Base-T port.

Management Port:

The DB9 connector on the left corner is the RS485 management port. It is used for monitoring of a point-to-point link. It is redundant when the LM is connected to a LMX. The pin definition of the RS485 port is given in Table 3-5.

Table 3-5 Pin definition of RS485 management prot

Pin	5	6	7	8	9	Shell
Sig.	GND	RxN	RxP	TxN	TxP	CGND

Note: Tx and Rx are relative to the LM. Unspecified pins should be left open.

Power Inputs:

The H9MO-LM can be powered either with -48VDC or 220VAC supply. The flip switch selects the power input. When flipped up, -48VDC is selected, and 220VAC is selected with switch flipped down. The middle position switches the power off.

Use standard AC power cord supplied with the unit to connect to the 220VAC power supply.

- Use power outlet with secure earth connection to avoid danger of electric shock.

-48VDC power supply is connected to the LM through the PWR-IN socket, a plug is supplied for the socket. Connect power wires to the plug according to Fig. 3-5. Insert the prepared wire end into the hole on the left end of the plug, tighten the screw to securely fix

the wire to the plug. After fixing all the wires, push the plug into the socket.

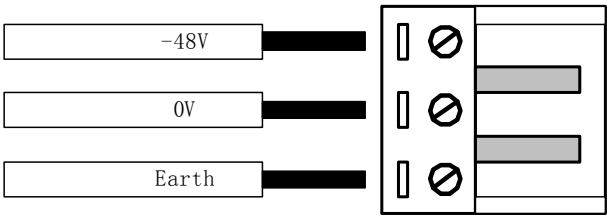


Fig. 3-5 -48VDC Connector Wiring

3.4 Physical Dimensions

H9MO-LM is housed in a standard 19 inch wide, 1 unit high compact metal case. The dimensions are shown in Fig. 3-6.

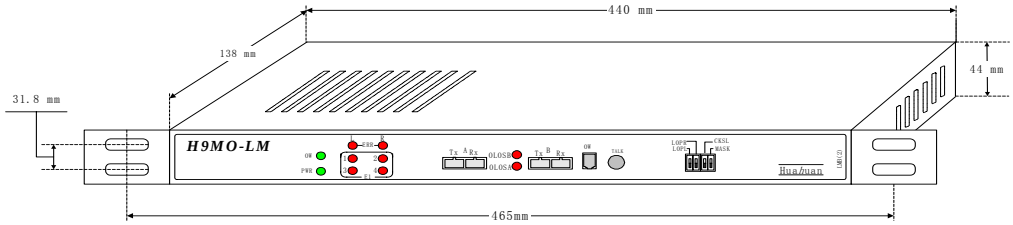


Fig. 3-6 H9MO-LM Chassis Dimensions

3.5 Installation and Operation

Connect power supply with correct voltage to the appropriate power-in sockets.

Connect fiber optic connectors into the FO socket on the front panel. Pay attention to the transmit and receive relationship. When plugging in the connectors, make sure the peg on the connector is aligned with the opening on the socket. Push firmly all the way until click. Do not drag the fiber when unplugging. Keep fiber bending radius above 50mm. Please keep aside the socket cap, and always cover the socket with the cap to prevent dust whenever fiber is removed.

Select correct clock mode. If the unit is to be connected to a LMX, it should operate in line clock mode, i.e. the CKSL dip switch on the right side of the front panel should be pressed down. If the LM is to be connected to another LM, select internal clock by placing the CKSL dip at the up position.

Switch on the power, the system starts to boot-up. The LED's may twinkle randomly. The boot-up takes about one second, and the system starts normal operation.

Check the alarm LED's. If the equipment on the far end is alive, the OLOS (OLOSA and OLOSB in the case of 1+1 protection configuration) and the ERR should all go off. Check fiber connections or the received optic power if some of these LED's shines. Since

the E1's are not connected yet, the E1 alarm LED's will be on.

Connect an E1 bit error tester to one of the E1 ports, press down the LOPL dip, no error should be reported. Lift up the LOPL dip, press down the LOPR dip, measure the bit error again to ensure that the link is error free. Lift up the LOPR dip.

Connect the E1 and the Ethernet cables to appropriate ports. Check their status LED's. The link should work as intended. The maximum channel bandwidth of the Ethernet is 100Mbit/s. However, the bandwidth may be modified by software down to 1Mbit/s in 1Mbit/s steps. The bandwidth setting is saved in non-volatile memory, so a previous setting may affect the current installation. Make sure the bandwidth is set as intended. If the LM is connected to the LMX, the bandwidth setting on LM will not take effect, thus avoiding potential unauthorized modification of bandwidth SLA at the CPE site.

If some of the E1 ports are not used, you may disable the relative alarm LED's by pressing down the MASK dip and lift up again. All current E1 alarms will be masked out hereafter. When in a future time the free E1 ports are used, the MASK dip should be flipped again with correct signal applied to the ports. A new alarm mask will then replace the previously set alarm mask.

4. 🕮H9MO-LMX

4.1 Structure

The LMX chassis is a multi slot aluminum box as shown in Fig. 4-1. It has 16 tributary slots labeled LIU's, 2 network interface slots labeled NIU's , 2 extended NIU slots labeled ENIU's, and slots for power cards labeled PWR's, a power connection card slot PWR-IN, and an auxiliary I/O card slot labeled AUX-IO.

PWR1	PWR-IN	LIU1	LIU3	LIU5	ENIU1	ENIU2	NIU1	NIU2	LIU7	LIU9	LIU11	LIU13	LIU15
PWR2	AUX-IO	LIU2	LIU4	LIU6					LIU8	LIU10	LIU12	LIU14	LIU16

Fig. 4-1 H9MO-LMX card slots

Each slot may hold a card form a selection of different cards. Table 4-1 lists available and planed cards. The table will be extended in the future with more card types to suit the needs of our customers.

Table 4-1 LMX Card Descriptions

Slot	Part No.	Description	Availability
LIU	OFE	Single port STM-1 FO line card with Ethernet interface, 4 VC-12 cross connect capacity, intended for linking a LM	✓
	OPFE	1+1 optical protection version of OFE	✓
	OFE16	Single port STM-1 FO line card with Ethernet interface, 16 VC-12 cross connect capacity, intended for linking a LMFIT	
	OPFE16	1+1 optical protection version of OFE16	
	OV16	Same as OFE16 but without Ethernet port, all traffic goes to cross connect	✓
	OPV16	1+1 optical protection version of OV16	✓
	OSUB8	Dual port FO line card at sub-STM-0 rate, 8 VC-12 capacity for each FO channel, may connect to 2 LMSUB's. No 1+1 protection option.	✓
	4XE1	4×E1 interface card	
	8XE1	8×E1 interface card	
	2XV35	2×V35 interface card	
	FE201	Dual port Ethernet interface card, Ethernet bandwidth 1~8×VC-12, one port has higher priority over the other.	
	4XFE	4×FEoE1 interface card	
	DXC16	16 E1 time slot cross connect card	
NIU	155-O	FO interface STM-1 network interface card, with built-in cross connect, SEC clock, network management, and orderwire sub blocks.	✓
	155-E	Same as 155-O except with electrical STM-1 interface	✓
	21XE1	Network interface through 21×E1 upstream connections.	
ENIU	GESW	Gigabit Ethernet switch card, with 16 FE ports connected to the FE ports on OFE cards, and 2 GE ports for data network connections	
PWR		Power card. Two cards provide 1+1 redundancy.	✓
PWR-IN		-48VDC connection card, dual input sockets for independent -48VDC power sources	✓
AUX-IO		Auxiliary I/O card, including external clock, alarm out, and OW phone jack	✓

The slot type and part number are indicated on the card panel as shown in Fig. 4-2.

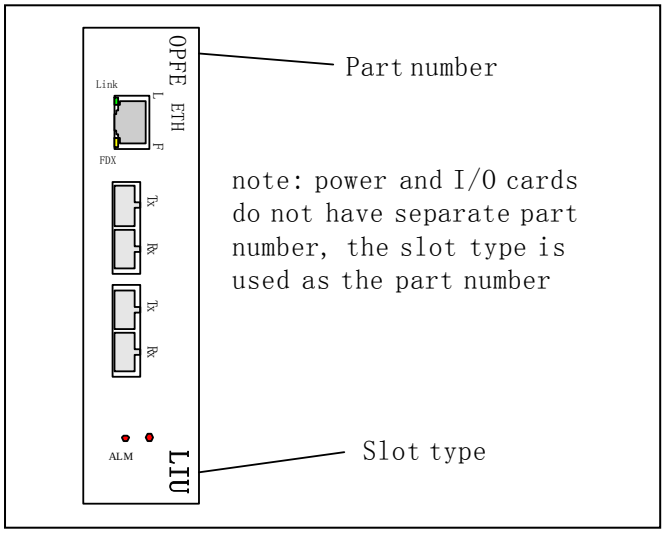


Fig. 4-2 Card identifiers

4.2 Functional Card

This section introduces cards that are currently available. New cards will be added when ready.

4.2.1 Power Connect Card (PWR-IN)

The power connect card is used to connect -48VDC power supply to the LMX. Two sets of power sockets can be used to connect to independent redundant -48VDC power sources. Both power sources are supplied to each of the power cards. Each power socket is associated with a LED indicator. Two connectors come with the card. They can be easily fixed to a power cable by the screws on the connector. Make sure the polarity is correct when connecting the connectors.

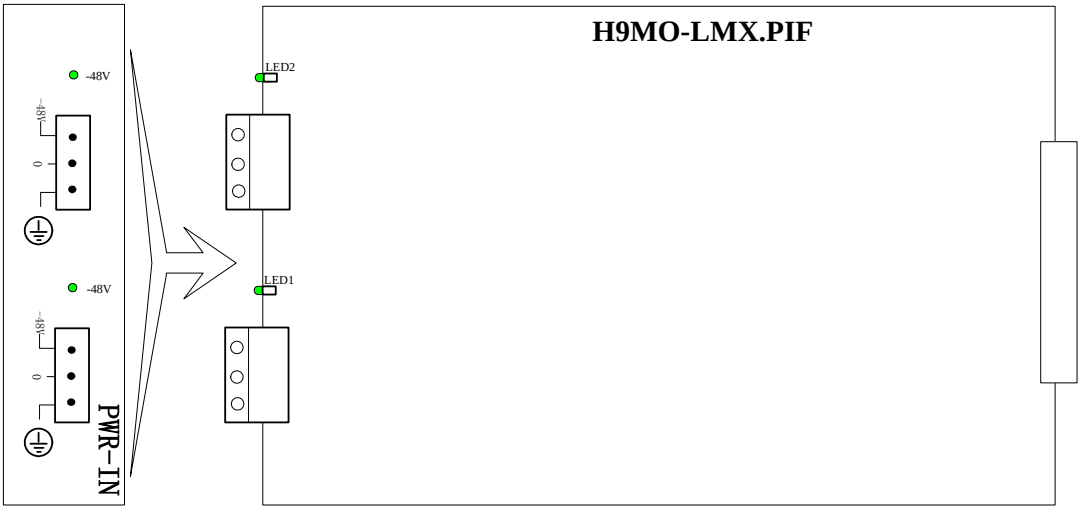


Fig. 4-3 PWR-IN Card

4.2.2 Power Card (PWR)

The power card converts -48VDC power supply to 5VDC internal voltage. Each card can supply 100 watts which is enough for a full LMX system power consumption. That is, the LMX can be powered with a single power card. But for higher operation reliability, it is recommended to use two power cards in 1+1 redundancy. Each power card has its own power switch.

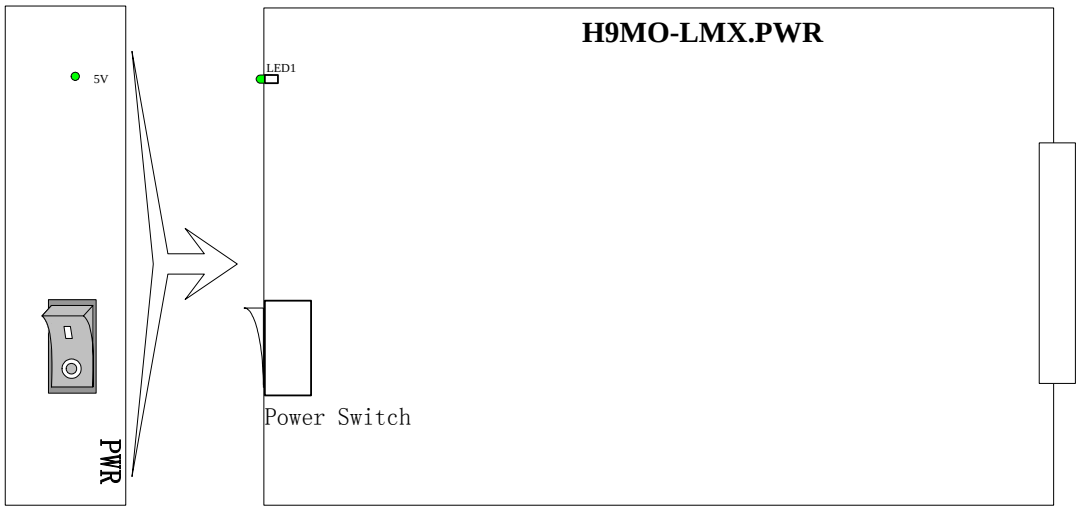


Fig. 4-4 Power Card

4.2.3 Auxiliary I/O Card (AUX-IO)

The AUX-IO card holds external clock ports, shelf alarm output pot, and orderwire telephone jack. The upper 3 BNC connectors are for external clocks, 2 clock inputs denoted INA and INB, and an output connector denoted OUT. In the middle is the shelf alarm output connector. The upper post is the prompt alarm pin, and the lower post is the differed alarm pin. When alarms present, the respective alarm output pin is earthed, otherwise it is floated. The RJ11 port at the bottom is the phone jack for orderwire telephone. This telephone is also used as a hand held input device for LCD menu selection.

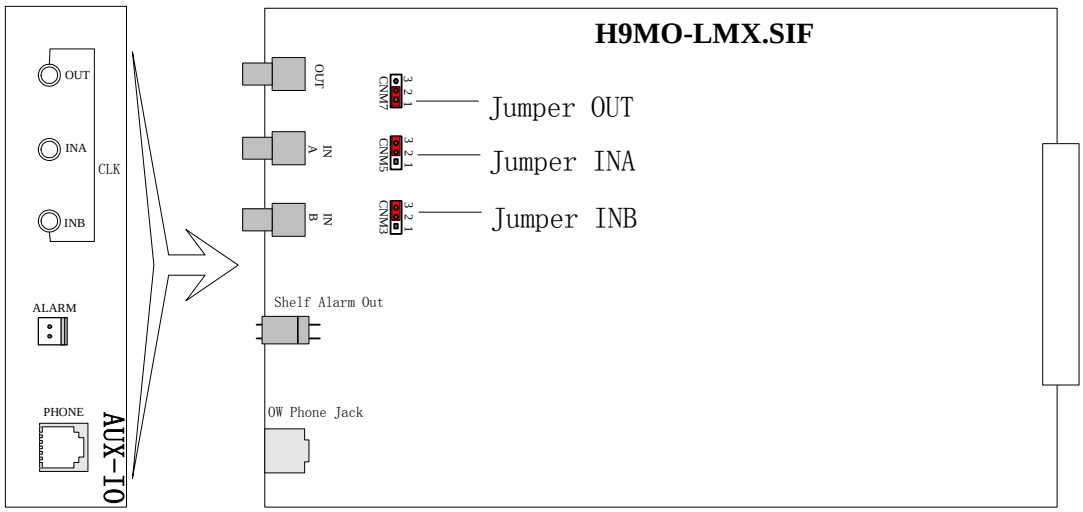


Fig. 4-5 Auxiliary I/O Card

Inside the card, there are 3 jumpers for setting the clock connector grounding. Table 4-2 describes the jumper functions. Sometimes when the external clock source and the LMX are not well earthed, change of grounding settings may be required. The best result may need to be found experimentally.

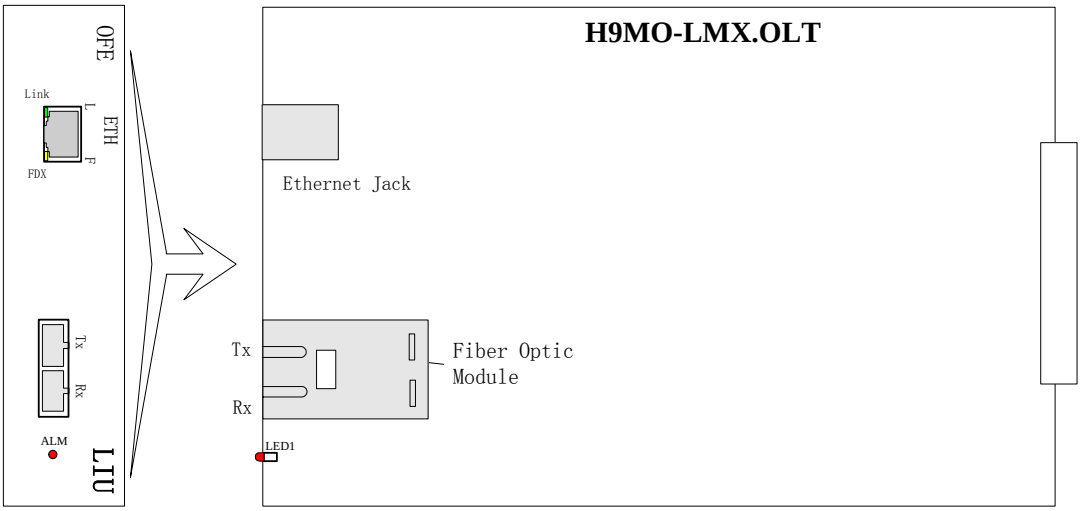
Table 4-2 AUX-IO Card Jumper Settings

Jumper	Setting
OUT	Output clock coaxial connector outer conductor grounding setting: Grounding (default): lower, Floating: upper
INA	Input clock A coaxial connector outer conductor grounding setting: Grounding: lower, Floating (default): upper
INB	Input clock B coaxial connector outer conductor grounding setting: Grounding: lower, Floating (default): upper

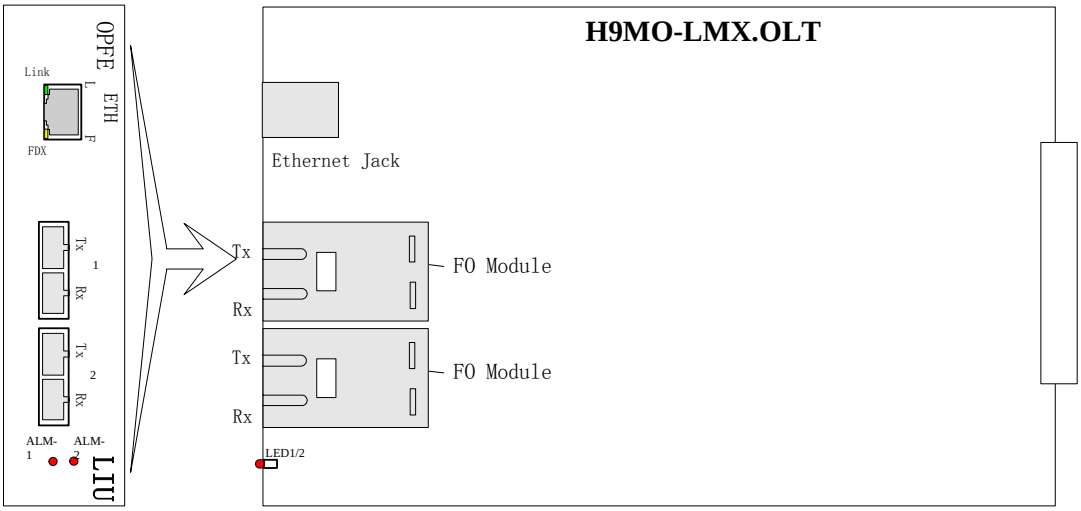
4.2.4 Tributary STM-1+FE Card (OFE, OPFE)

The tributary STM-1+FE card is designed to connect to a LM unit, or other CPE's with STM-1 fiber optic port. The Ethernet traffic from the remote LM is terminated at the ETH port on the card, while the VC-12's bearing E1 traffic within the STM-1 stream are sent to the NIU cards through backplane. The Ethernet signal is also routed to the ENIU slots on the backplane, for future connection to the embedded Gigabit Ethernet switch board.

The OFE is the standard tributary card, while the OPFE the 1+1 protection version. A few LED's on the card are used to show the status of the FO ports and the Ethernet port, as listed in Table 4-3.



(a) OFE/LIU



(b) OPFE/LIU

Fig. 4-6 OFE and OPFE LIU Cards

Table 4-3 LED's on OFE and OPFE LIU Cards

Label	Color	Description	Note
ALM ALM-1 ALM-2	R	FO port alarm On: loss of optical signal Wink: receive bit error Off: normal operation	For single and protected FO ports

ETH-L	G	Link indication	On the RJ45 jack
ETH-F	Y	Duplex mode indication On: full duplex mode Off: half duplex mode Wink: collision	

The RJ45 pin out is given in Table 4-4. The actual Ethernet bandwidth may be set through management software, from full 100Mbit/s down to 1Mbit/s in 1Mbit/s steps.

Table 4-4 RJ45 Pin Out

Pin	1	2	3	4	5	6	7	8
Sig.	TxD+	TxD-	RxD+			RxD-		

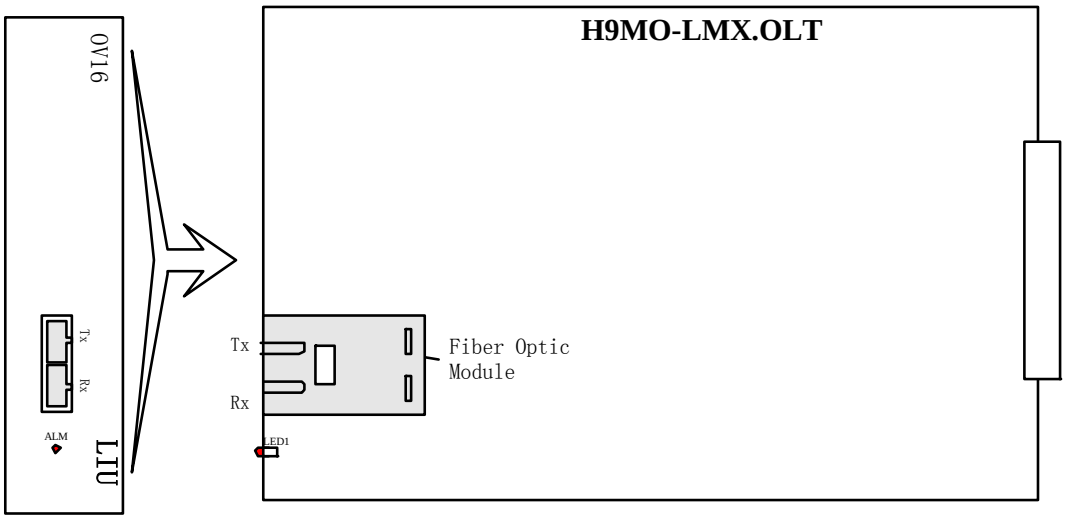
Note: The port is HP auto-MDIX compliant, it will automatically adapt to MDI or MDI-X interfaces. That is, either parallel or crossover cables can be used to connect to any 10/100Base-T port.

4.2.5 Tributary STM-1 Card (OV16, OPV16)

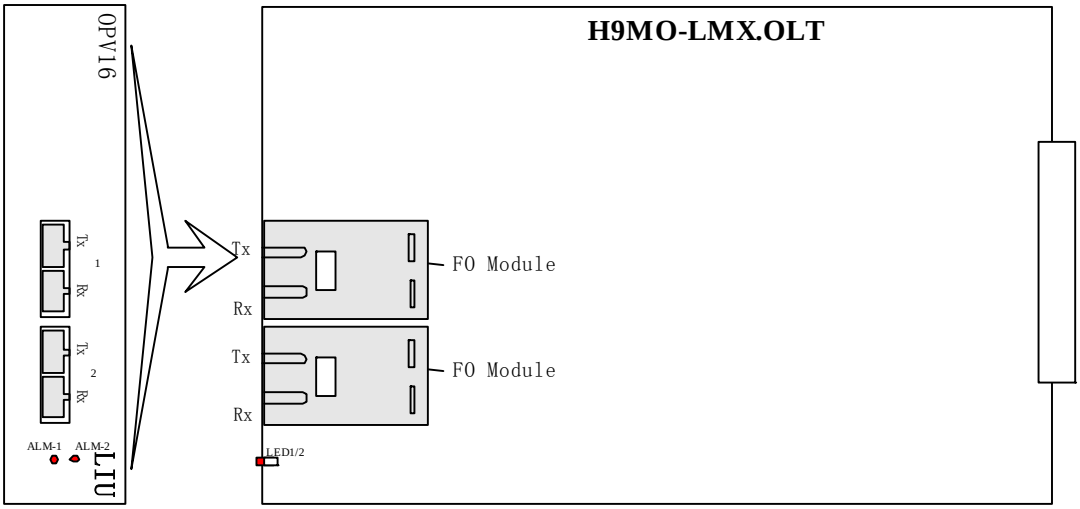
The tributary STM-1 card is similar to OFE and OPFE cards but without the FE interface. The backplane cross-connect capacity is 16 VC-12's, while the OFE and OPFE cards support only 4 VC-12's. It is designed to connect to a LMFIT or a LM, or other CPE's with STM-1 fiber optic interface, without locally terminated Ethernet port.

The OV16 is the standard tributary card, while the OPV16 the 1+1 protection version.

Two LED's on the card are used to show the status of the FO ports, similar to that on the OFE and OPFE cards, as listed in Table 4-3.



(c) OV16/LIU



(d) OPV16/LIU

Fig. 4-7 OV16 and OPV16 LIU Cards

4.2.6 Tributary Sub-STM-0 Card (OSUB8)

The tributary Sub-STM-0 card is similar to OV16 card, differ in two main aspects: the optical line rate is sub-STM-0 instead of STM-1, and there are two independent fiber optic interfaces that can connect two separate remote CPE's. This increases the number of CPE's a LMX can support, from 16 to 32, but with lowered capacity for each CPE.

The CPE connected to OSUB8 must be H9MO-LMSUB. The backplane cross-connect capacity is 16 VC-12's, 8 for each link.

Two LED's on the card are used to show the status of the FO ports, similar to that on the OPFE card, as listed in Table 4-3, but they represent status on links to two separate CPE's, instead of the 1+1 protected links to the same CPE.

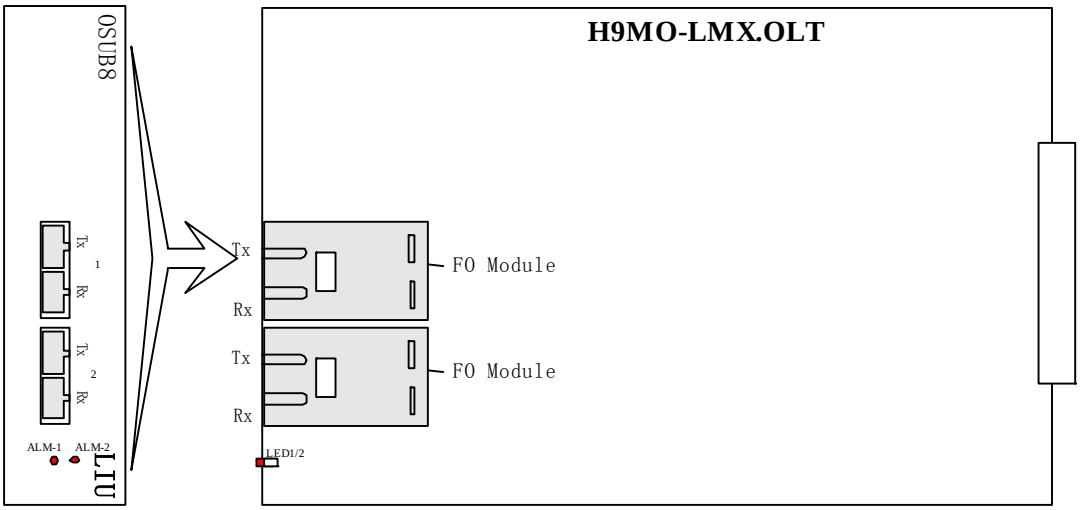


Fig. 4-8 OSUB8 LIU Card

4.2.7 STM-1 Network Interface Card (155-O, 155-E)

The STM-1 NIU card on a LMX aggregates VC-12 traffic from all tributary LIU's into a STM-1 stream. It is the interface card to the core SDH transport network. This card is highly integrated. In addition to STM-1 framing and multiplexing functions, the card also contains functional blocks such as a 382×382 VC-12 cross connect matrix, the SEC clock subsystem that confirms to ITU-T G.813, the micro-controller, and the orderwire telephone subsystem. All these functional blocks can work in 1+1 redundant mode if both NIU cards are installed in the same LMX.

Differ in STM-1 physical interfaces, the STM-1 NIU card comes in two versions. The 155-O is optical, and 155-E is electrical. Otherwise they are identical. Fig. 4-9 shows both interfaces on the same card, representing both 155-O and 155-E.

On the face panel, there are 4 LED's, the STM-1 sockets (BNC for 155-E, and SC for155-O), a DB9 console connector, and a 10Base-T network management port. Inside the 155-E there are 2 jumpers behind the BNC sockets, denoted CNM5 and CNM6, for grounding the outer conductors of the BNC coaxial socket. Another jumper at the lower right corner, denoted CNM13, is used to select output system clock mode. The meanings of the LED's are given in Table 4-5, and the jumper settings are explained in Table 4-6.

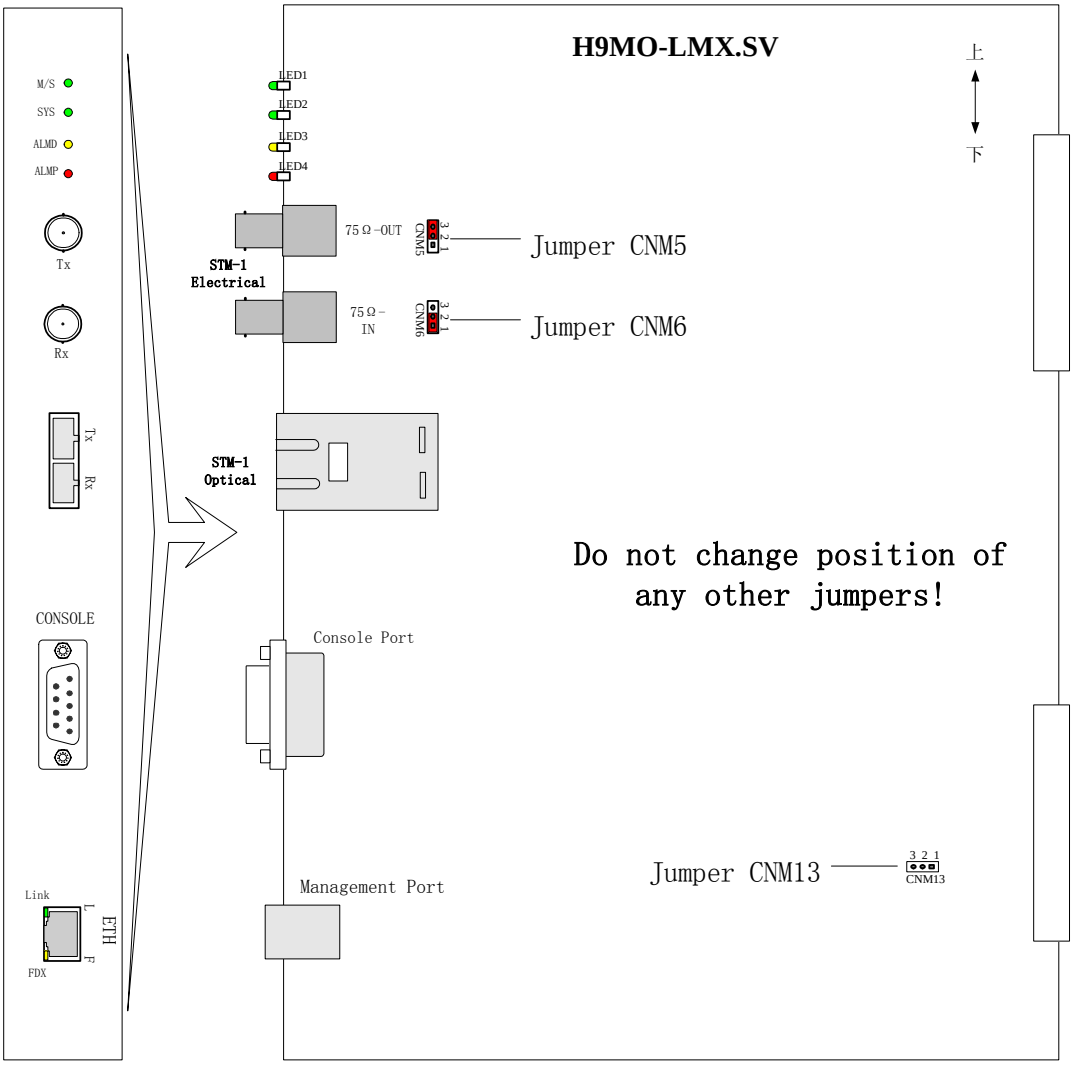


Fig. 4-9 STM-1 NIU Card

Table 4-5 STM-1 NIU Card LED Description

Label	Color	Description	Note
M/S	G	Master/slave indicator. On represents the master when	

Label	Color	Description	Note
		two cards are installed in a 1+1 redundant operation.	
SYS	G	Operational indicator. Winks during normal operation.	
ALMD	Y	Deferred alarm.	Alarm trigger set by software
ALMP	R	Prompt alarm / Loss of signal indicator Wink: Prompt alarm, On: Loss of incoming STM-1 signal	
ETH-L	G	Link indicator	LED's On the RJ45 jack
ETH-F	Y	Duplex indicator On: full duplex Off: half duplex Wink: collision	

Table 4-6 Jumper setting on STM-1 NIU Card

Jumper	Settings		
CNM5	STM-1 output BNC outer conductor grounding select (155-E only) Upper: grounding(default) , Lower: float		
CNM6	STM-1 input BNC outer conductor grounding select (155-E only) Upper: grounding , Lower: float(default)		
CNM13	External clock format	2Mbit/s	Left (default)
		2MHz	right

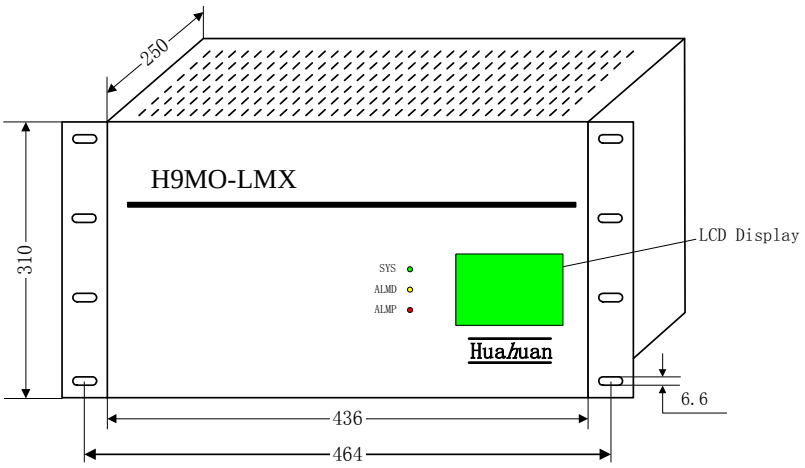
4.3 Installation and Operation

4.3.1 Mechanical

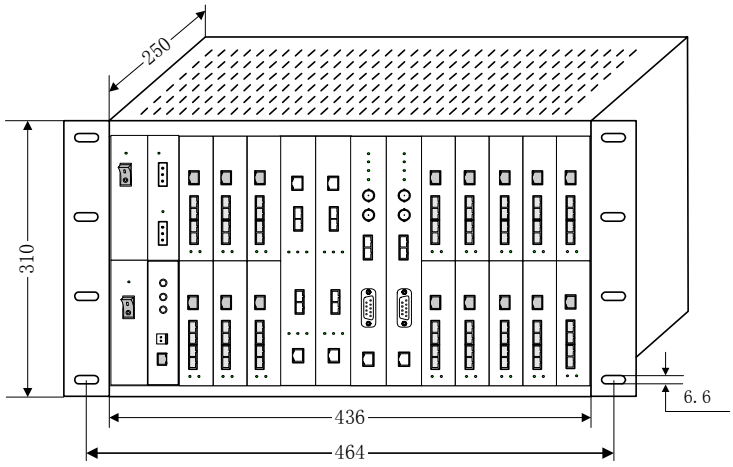
The aluminum chassis of LMX is 19 inches wide and 7 U in height. The chassis is "dual front", meaning that the mounting ears can be attached to either side of the box, as shown in Fig. 4-10 (A) and Fig. 4-10 (B). When side A is used as the front panel, 3 LED's indicate system alarm status in general, and detailed alarm information is shown on the LCD display. If side B is the front, alarms are indicated by a number of LED's on individual cards. The 3 LED's on side A are explained in table 4-7.

Table 4-7 LED's on Side A of LMX

Label	Color	Description
SYS	G	Winks when system is in operation.
ALMD	Y	Winks to indicate differed alarms.
ALMP	R	Winks to indicate prompt alarms.



(A) Back plane side



(B) Slot side

Fig. 4-10 The LMX Chassis

4.3.2 Connect Power

-48VDC power supply is connected to the LMX through the PWR-IN card. There are 2 power sockets on the PWR-IN card. They can be connected to independent -48VDC power sources that back up each other.

On each power connector, there is a plug inserted in the socket. Pull off the plug, and connect power wires to the plug according to Fig. 4-11. Insert the prepared wire end into the hole on the left end of the plug, tighten the screw to securely fix the wire to the plug. After fixing all the wires, push the plug into the socket.

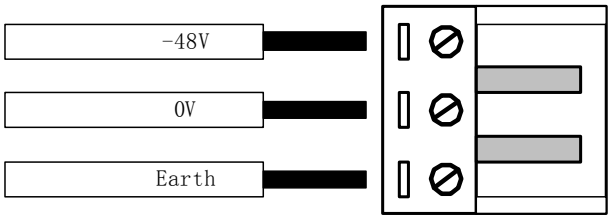


Fig. 4-11 Power Plug Connection

4.3.3 Connect Optic Fiber

Connect SC type fiber optic connectors into the SC socket on appropriate cards. Pay attention to the transmit and receive relationship. When plugging in the connectors, make sure the peg on the connector is aligned with the opening on the socket. Push firmly all the way until click. Do not drag the fiber when unplugging.

On cards with single fiber transmission option, only one fiber socket is used for both input and output. Single fiber module transmits and receives optical signals in different wavelengths. Usually, the single fiber version LIU on LMX transmits at 1310nm, and single fiber LM transmits at 1550nm.

Keep fiber bending radius above 50mm. Please keep aside the socket cap, and always cover the unused socket with the cap to prevent dust from entering the optical module.

4.3.4 Network Management Connection

On the NIU card, there are two connectors for connecting to the management computer, a 9-pin D connector console port, and a RJ45 Ethernet port.

The console port is a RS232 serial port for command line access to the internal microcontroller system. Pin definition for the D connector is given in Table 4-8. The console port can be connected to a VT100 dummy terminal, or a PC running terminal emulation program such as the windows HyperTerminal. The console port protocol is 9600 baud, 8 data bits, 1 stop bit, no parity, no flow control. The main function of the console is to modify hardware parameters such as the node address, etc. It can also be used to check operational status, or issue simple commands. The command input is not case sensitive. Console access is password protected. Default username is “admin”, and default password is “hhpostern”. The user can change the user name and password. If no key stroke is performed in 3 minutes, the system will automatically log off.

Table 4-8 Console Port Pin Definition

Pin	1	2	3	4	5
Sig.		Rx	Tx		GND

The RJ45 is used to connect to a management workstation running network management software, such as the H7GMSW. It is a MDI 10Base-T port, and can be

connected to the LAN using standard Ethernet cable like any other computer.

4.3.5 Orderwire Telephone

The RJ11 jack labeled PHONE on the AUX-IO card is the orderwire telephone socket. It may connect any standard telephone in DTMF mode. The orderwire telephone is used to establish a service call between the LMX and LM's connected to its LIU's.

Initiating a call at the LMX side is achieved by dialing a number representing the intended LM. The call number starts with an asterisk key '*', followed by the 2-digit number from 01 to 16, corresponding to the LIU slot positions on the LMX, as shown in Fig. 4-1. For example, to call the LM connected to LIU3, one should dial '*03'.

At a LM, one can only call the LMX, but not other LM's. Therefore, initiating a call at the LM side is in a hot-line fashion, by pushing down the "TALK" button on the front panel. The button is also used to receive a call to indicate the off-hook condition.

4.3.6 LCD Display and Menu Operation

The telephone set at the LMX has another function, that is, act as handheld terminal to select menu items on the LCD screen on the side A of a LMX chassis, as shown in Fig. 4-10 (A). Double push on the asterisk key '**' enters menu operation mode. In menu mode, keys 2, 4, 6, 8 are used as cursor movement keys, and key 5 act as enter key. The key definition is shown in Fig. 4-12. Hang up the phone leaves the menu mode.

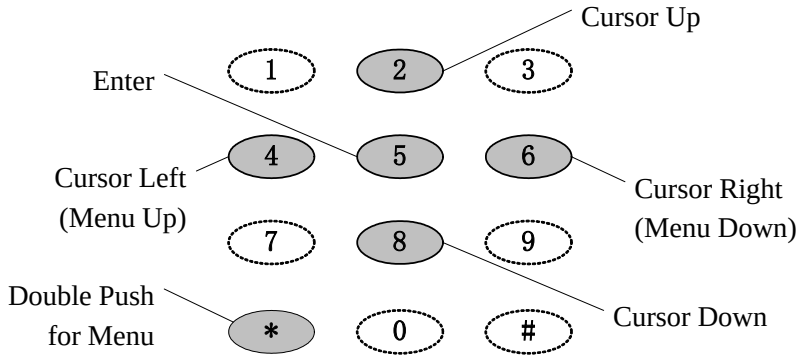


Fig. 4-12 Menu Key Definition

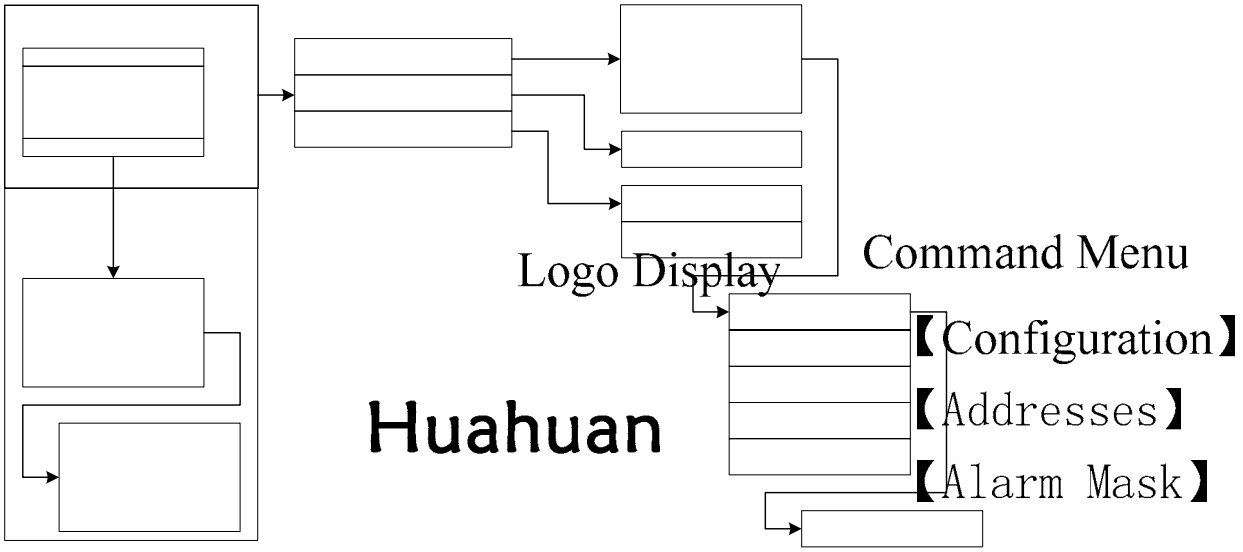


Fig. 4-13 Menu Expansion Diagram

4.3.6.1 Alarm Menu

Alarm Menu

When no alarms present, the LCD screen displays the “Huahuan” logo. If alarm conditions arise, the display changes to alarm indication, showing all installed cards, with blinking ones representing cards with alarms, as shown in Fig. 4-14. Half height slots are represented by single letters, and full height slots are represented with stacked double letters, as defined in Table 4-9. Uninstalled slots are left empty in the display, but missing of an installed card will generate alarm represented by a flashing letter.

Alarm Indication

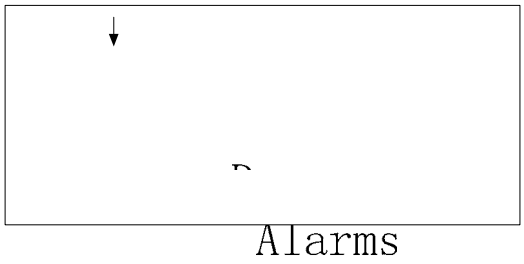


Fig. 4-14 Alarm Indication Display

Table 4-9 Letters Representing Occupied Slots

Slot	Power	AUX-IO PWR-IN	LIU	NIU	ENIU
Letter	P	I	L	N N	E E

The downward arrow ‘↓’ and upward arrow ‘↑’ are used as cursors to point to a slot

position for further alarm inquiry. The arrow is moved with cursor movement keys on the phone. Move the arrow to a slot in question, press enter key (key 5), brings up the detailed alarm list. Alarms are shown in Table 4-10.

Table 4-10 Alarm Definition

Display	Definition
CARD ABSENT	Installed card is missing or power failure
LOS, LOS1, LOS2	Loss of SDH signal (n)
SF	SDH Signal Failure
SD	SDH Signal Degrade
E1 LOS 1（2、3、4）	Loss of E1 signal at port 1 (2,3,4)
ETH LNK FAIL	Ethernet link failure

For a LIU, alarm items on both local card and on remote LM are displayed, represented by L and R respectively, such as:

LIU [05 L] ALM：

<Alarm contents on the LIU5>

LIU [05 R] ALM：

<Alarm contents on the LM connected to LIU5>

Note:

◆The LCD will enter into alarm indication display only when alarm conditions exist.

◆ With alarm conditions exist, off-hook the telephone automatically enters into cursor operation mode. If keys are not pushed within 10s, the phone will leave cursor mode, and busy tone is heard. One must hang up the phone and pick it up again to re-enter the cursor mode.

◆Using cursor and enter keys can bring up detailed alarm display only if the slot does have alarm conditions.

◆One can make phone call in cursor mode by dial *NN where NN is the intended number.

4.3.6.2 Command Menu

Double press asterisk key enters into command menu mode. There are three menu items on the command menu. Move up and down key to highlight a menu item, and right key brings out the submenu. Fig. 4-15 shows the configuration submenu, which displays currently installed cards.

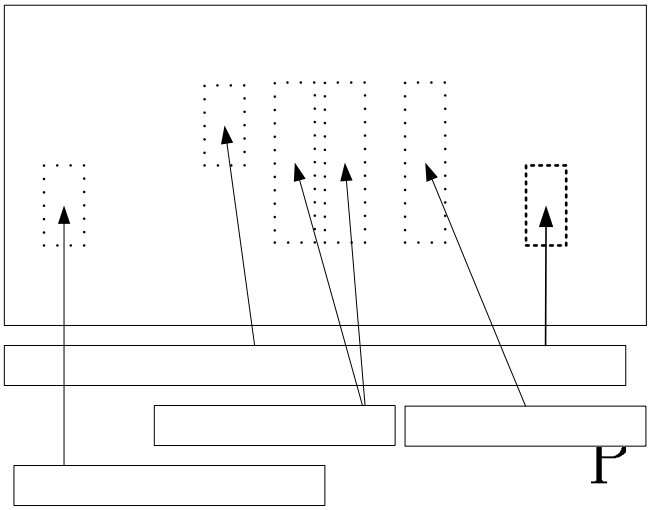


Fig. 4-15 Configuration Submenu

Press cursor right key moves to next level menu, displaying all installed cards. Highlight a card, move to next level menu, the software and hardware version of the installed card is displayed.

The address submenu displays the address information of the LMX equipment. Four addresses are displayed, from line 1 to line 4:

IP address of this LMX node

Sub-network address mask

Default gateway IP address

MAC address of Ethernet management port of this node

The alarm mask submenu is used to set or clear alarm masks. All alarms persisting at the time of issuing Set Alarm Mask command will be masked out. In other words, these defects will not generate alarms. The Clear Alarm Mask command will clear any alarm mask previously set. Note that both set and clear alarm commands are effective only to the local LMX, it will not affect alarm masks at remote units.

4.3.7 Shelf Alarm Output

On the AUX-IO card, there is a connector labeled ALARM, which is the shelf alarm output connector. The upper pin is the prompt alarm output, and the lower pin is the deferred alarm output. Defects triggering the respective alarm outputs are set by management software, and can be masked out by Set Alarm Mask command.

The alarm condition is represented by grounding the output pin. Otherwise, the pin will be floated. A separate product, the shelf alarm unit with 8 pairs of alarm input, can be used to generate audible alarm siren. Connection between the LMX and the shelf alarm unit

is made by inserting each end of an alarm cable into the alarm ports, see Fig. 4-16.

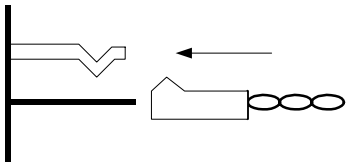


Fig. 4-16 The Alarm Connector

4.3.8 External Clocks

Up to 2 external clock signals may be connected to LMX for synchronization. It can also output a clock for reference. The nominal clock frequency is 2048 kHz, but may be in 2048 kbit/s format.

The clock connections are made to the 3 coaxial connectors, 2 inputs and 1 output, on the AUX-IO card. Choice for the coaxial connector outer conductor grounding is set by 3 jumpers on the AUX-IO card as described in section 4.2.3. But the clock format selection is made by a jumper on the NIU card, see section 4.2.5. Note that the clock format can not be independently set for the three clock signals.

5. 🕮Network Management

An access network built with MetroEdge-Express product can be managed with the network management software package H7GMSW. The detailed description of the software should refer to its user manual and online help. Here, only brief introduction is presented.

5.1 H7GMSW Introduction

The H7GMSW is a GUI based network element management software package. It supports both SNMP and TABS protocols. At the physical layer, SNMP uses Ethernet, while TABS uses RS485 to connect to the monitored equipment. LMX supports SNMP, and LM supports TABS only.

The software models the monitored network in 3 different perspectives: the network/area view, the site/element view, and the equipment/card view. In the network/area view, icons represent equipment sites are connected with lines representing fiber optic connections, forming networks. Double click on a site icon enters into the site/element view. Installed equipment in the site are graphically represented. Double click on the equipment or cards inside the equipment brings up the equipment/card window. Alarms will be indicated at any level by flashing the respective icons, and detailed defects are shown at the

equipment/card window. Control on individual equipment or card is also done at that window. Control at the network level, such as channel allocation, is done at the network/area window.

A software model of a piece of equipment must first be placed in the site/element view for that equipment to be monitored by the software. The graphical representation of the H9MO-LMX is shown in Fig. 5-1. After placing all the equipment into respective sites, they are connected to form a fiber optic network by connecting site icons at the network/area window.

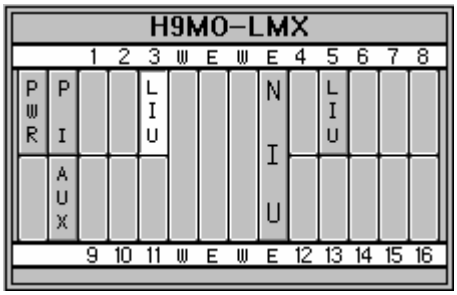


Fig. 5-1 H9MO-LMX Icon

Communication to the monitored equipment depends on its IP address. The actual address of a physical equipment is set through its console port. The icon module on the PC must have corresponding settings, set at the node address window as shown in Fig. 5-2. This window is brought up by double click on the LMX icon. Note that the double click should be performed on the LMX frame rather than on one of the cards, otherwise a window for that card will be activated. For example, if the double click is done at the lower PWR card, the Fig. 5-3 window appears.

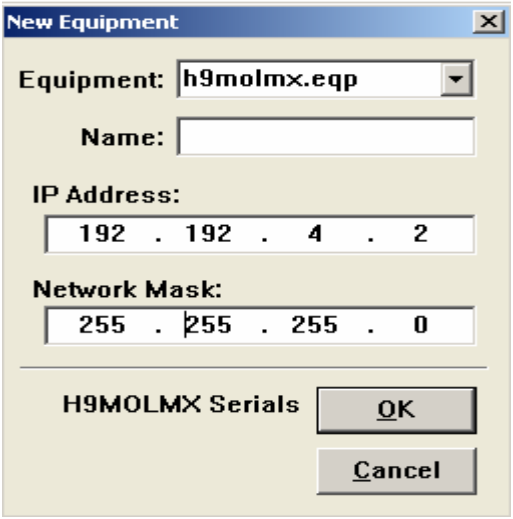


Fig. 5-2 Node Address Info Window

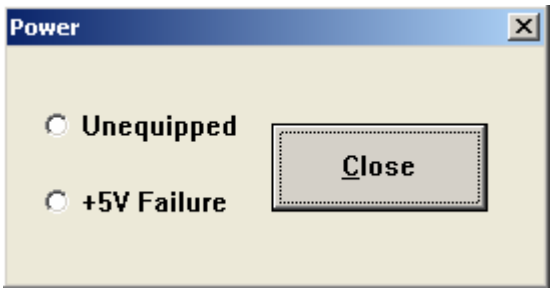
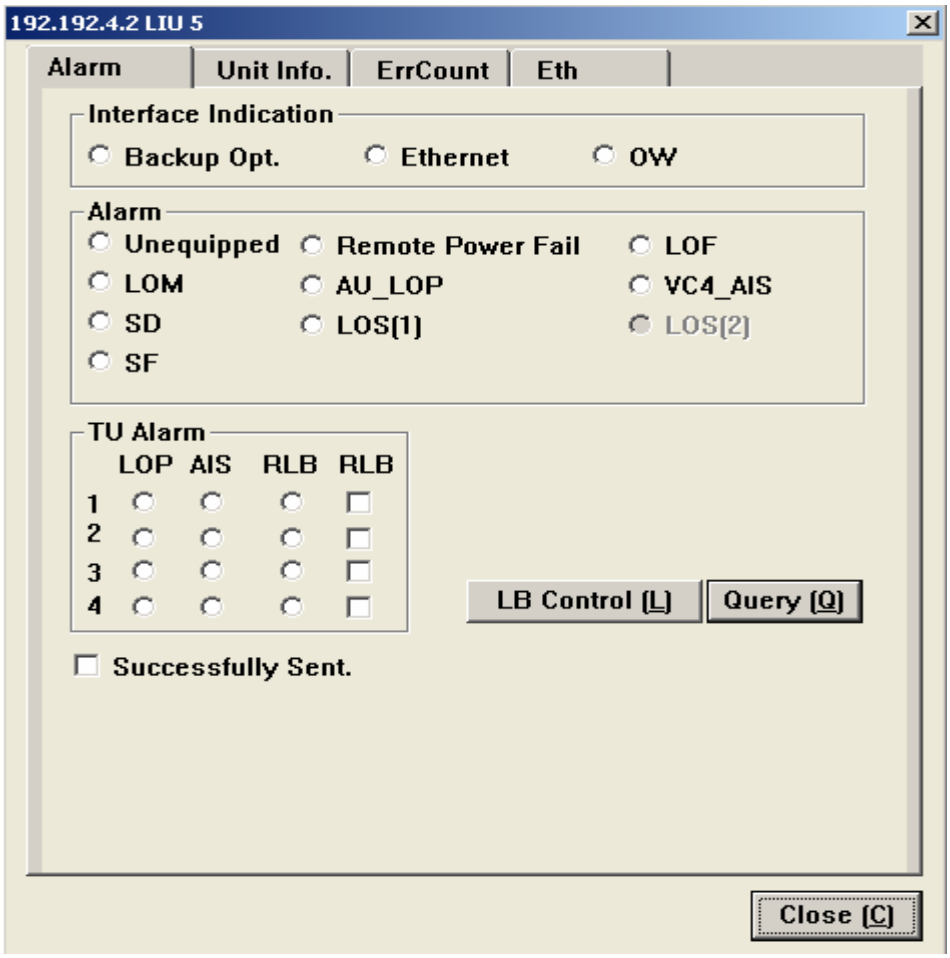


Fig. 5-3 Power Card Monitor Window

Double click on a LIU brings up the LIU monitor window as shown in Fig. 5-4. In the window, alarming items are represented by a dot in appropriate circles. Control commands such as E1 loop-backs and Ethernet bandwidth settings are also set through dialog boxes in the window. There are buttons on the window, some are command activation buttons such as “set” and “exit”, and other buttons may bring up a next level window. For example, click on the ErrCount button activates BER monitor window as shown in Fig. 5-5.


192.192.4.2 LIU 5
Alarm
Unit Info.
ErrCount
Eth
Interface Indication
Backup Opt.
Ethernet
OW
Alarm
Unequipped
Remote Power Fail
LOF
LOM
AU_LOP
VC4_AIS
SD
LOS(1)
LOS(2)
SF
TU Alarm
LOP
AIS
RLB
RLB
1
2
3
4
LB Control (L)
Query (Q)
Successfully Sent.
Close (C)

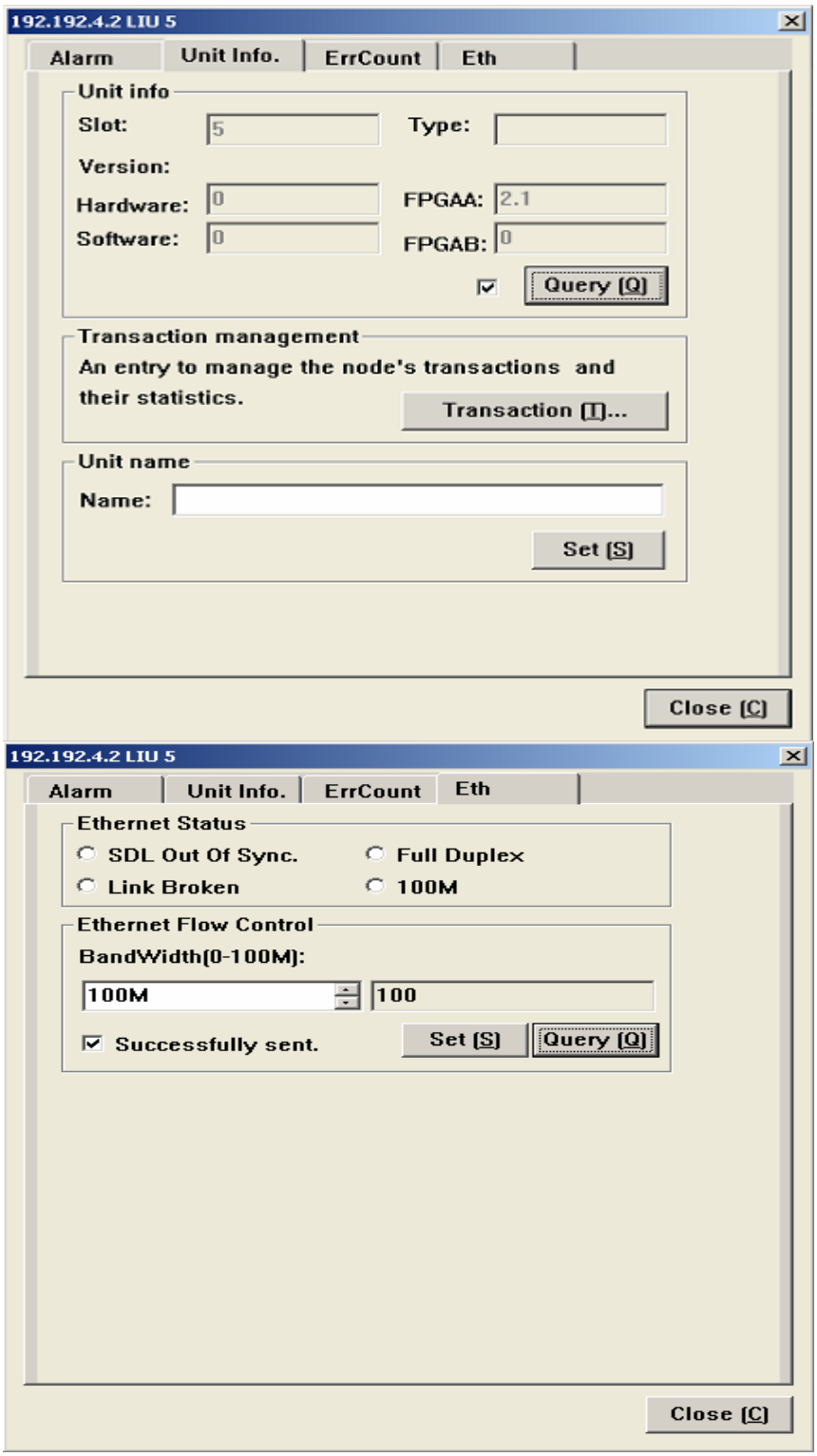


Fig. 5-4 OPFE/LIU Card Monitor Window

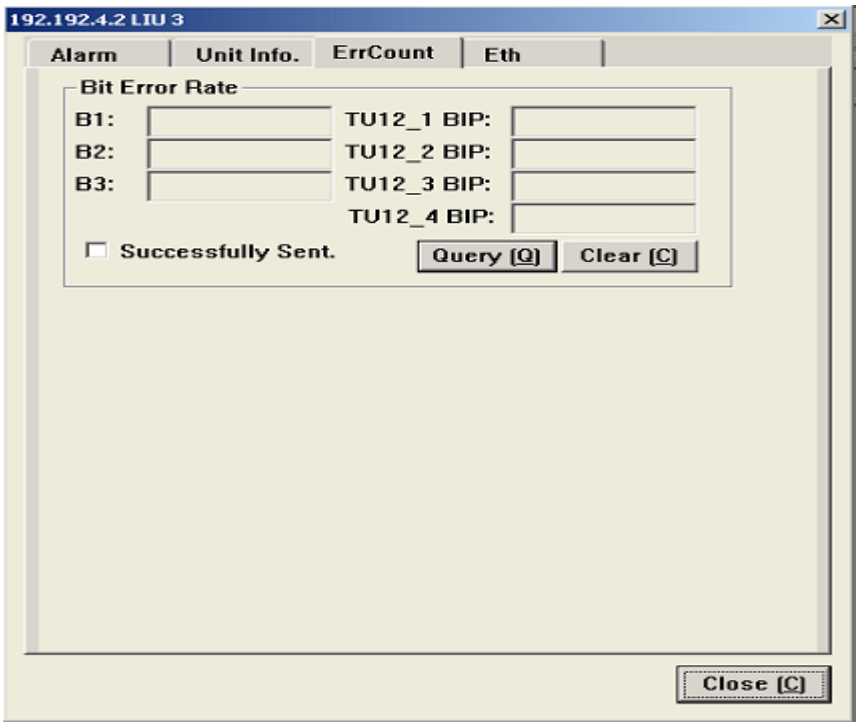
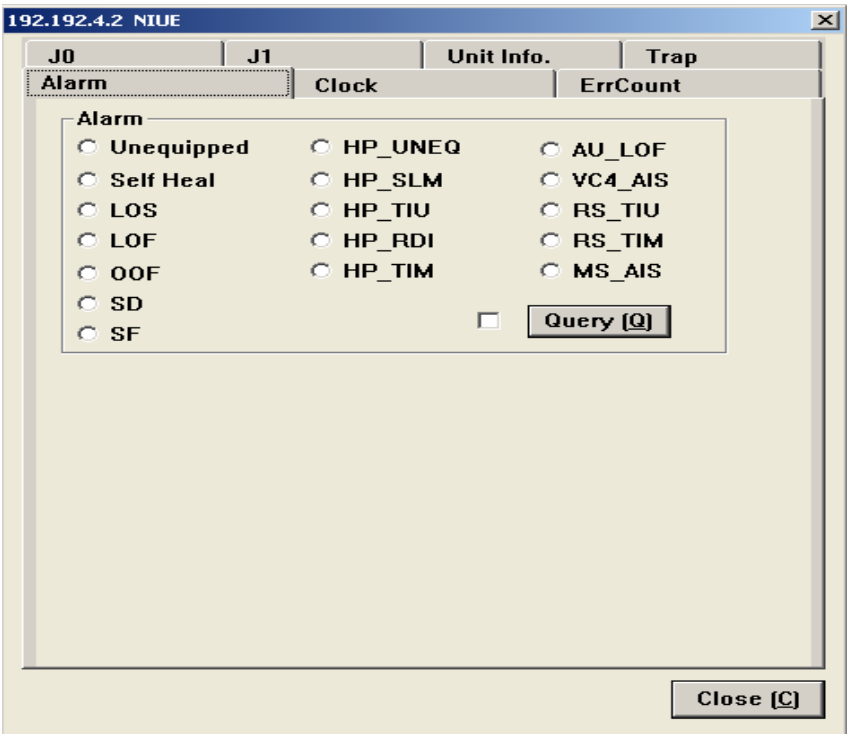
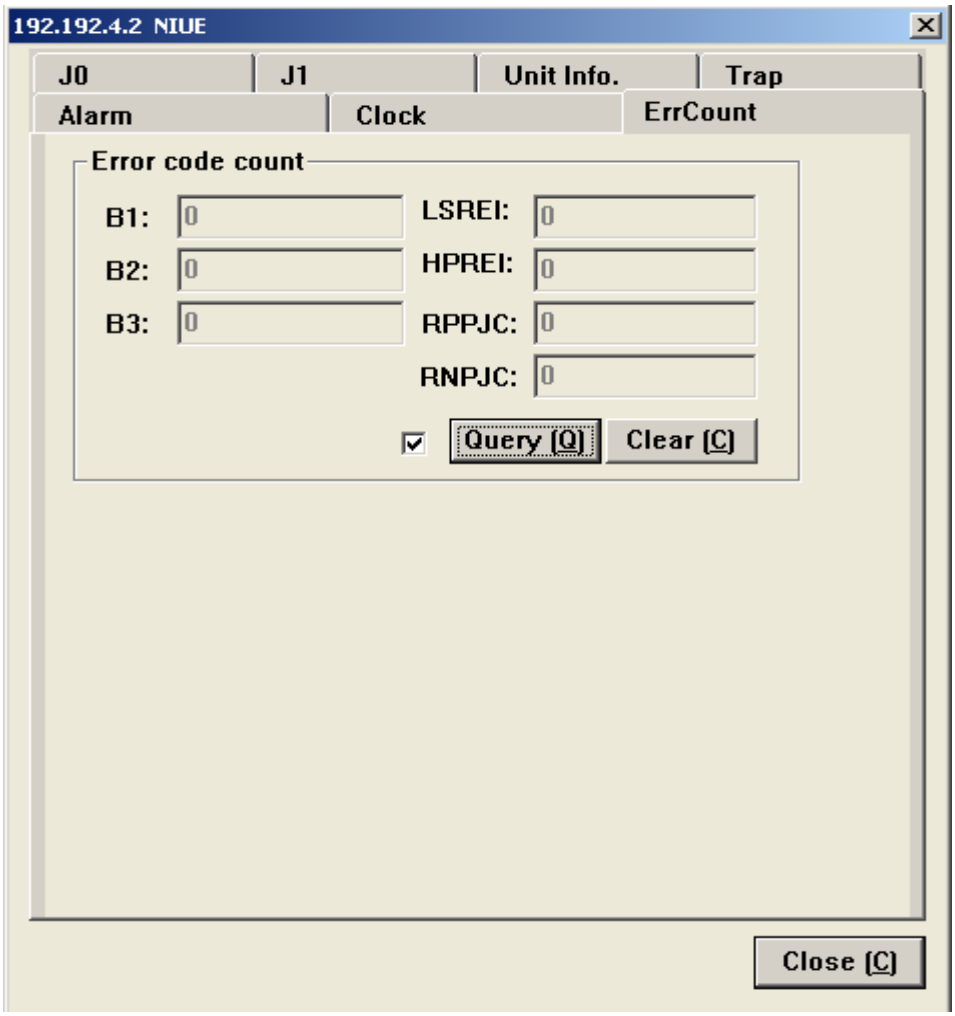


Fig. 5-5 BER Window

The NIU monitor window is shown in Fig. 5-6.




192.192.4.2 NIUE
J0
J1
Unit Info.
Trap
Alarm
Clock
ErrCount
Error code count
B1:
0
B2:
0
B3:
0
LSREI:
0
HPREI:
0
RPPJC:
0
RNPJC:
0
Query (Q)
Clear (C)
Close (C)

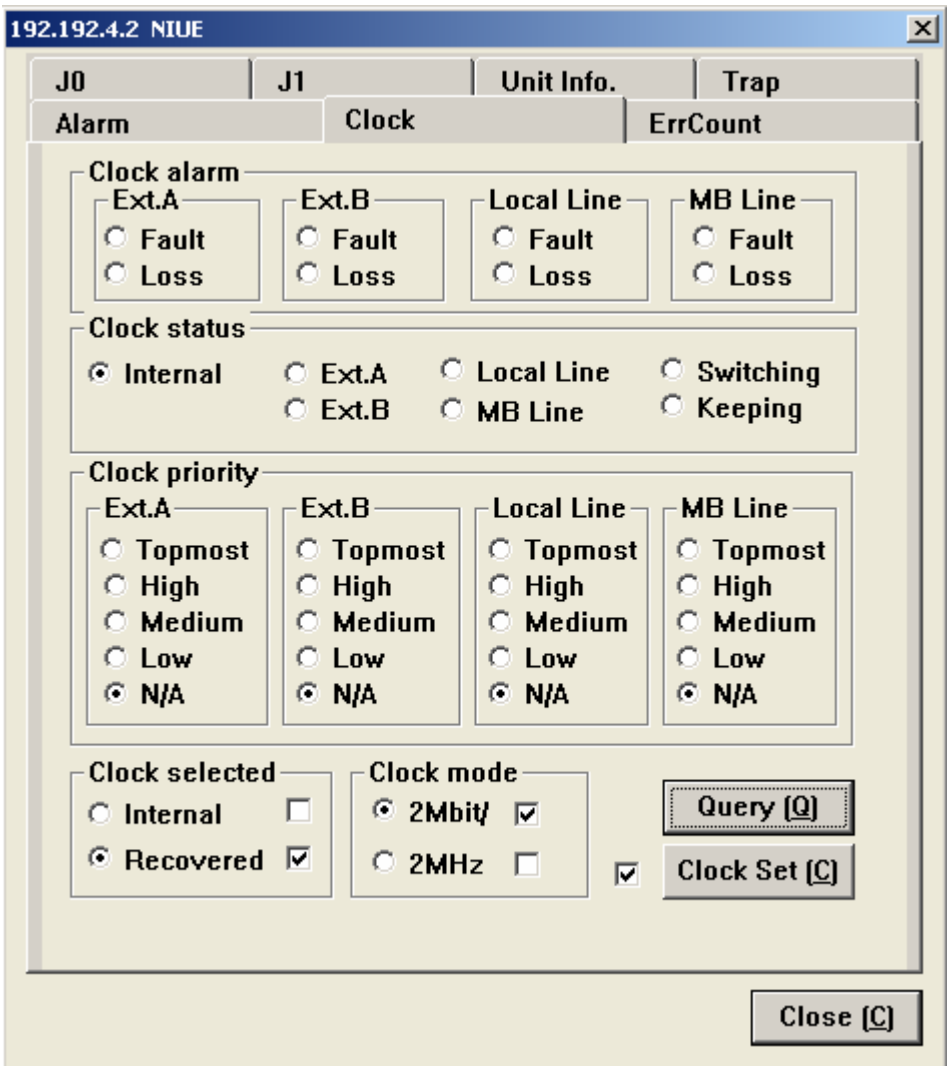


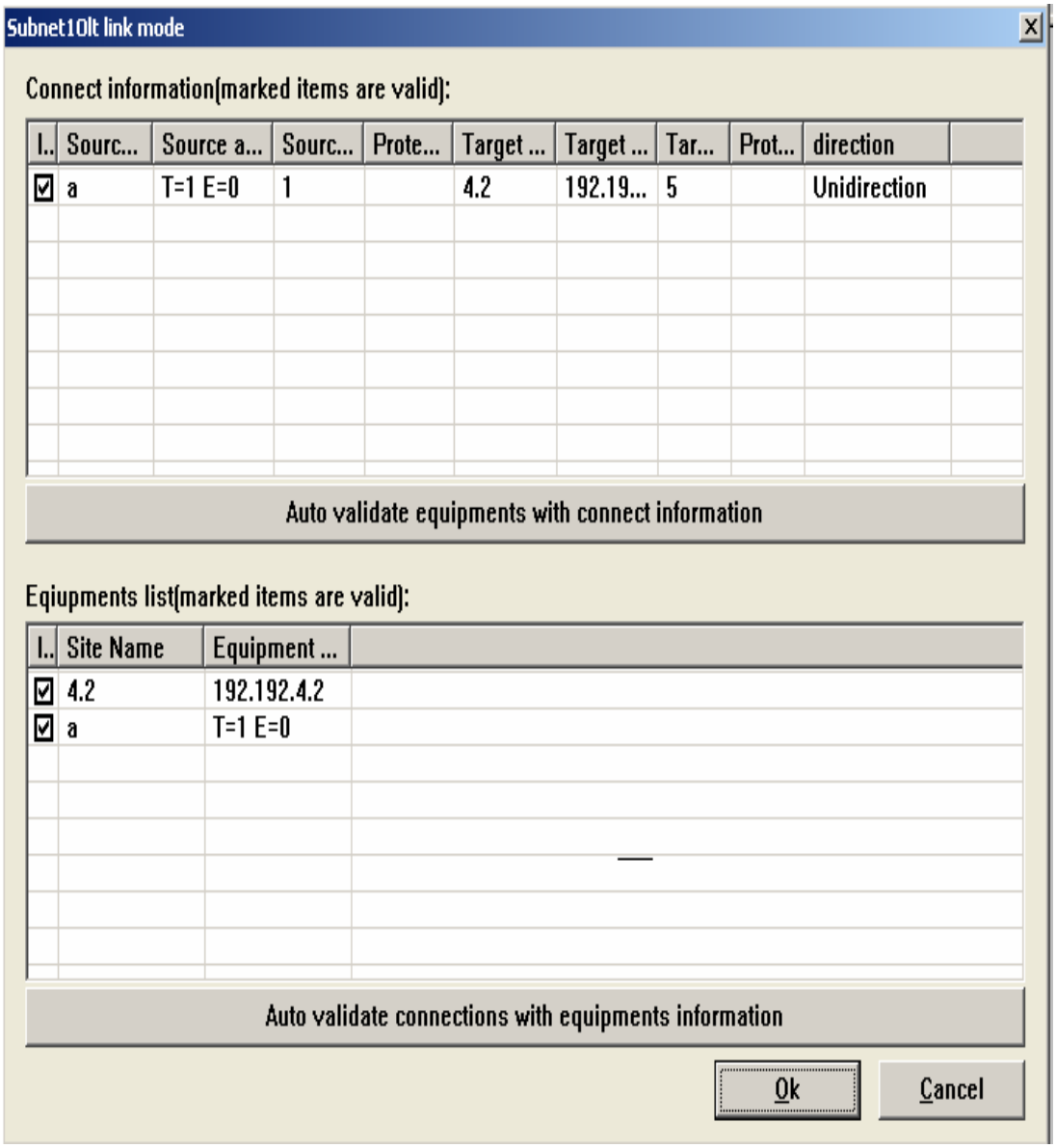
Fig. 5-6 NIU Monitor Window

5.2 Channel Allocation

Association or allocation of TU-12's among the upstream STM-1 and the LIU's are achieved by setting the cross connect matrix. In PDH days, such association is done manually on a DDF by arranging E1 cables. Therefore, the channel allocation command window is also called the "virtual DDF".

On the network/area window, select pull-down menu: Network→Channel Allocation, the mouse cursor changes shape to "☝". Move the cursor to a line representing a link of the fiber optic network you want to allocate channels, all links belong to the same sub network changes color. Click on the network brings out the channel allocation command window, as shown in Fig. 5-7. In the window, TU-12 from different LIU's and NIU's are

paired to form the association.



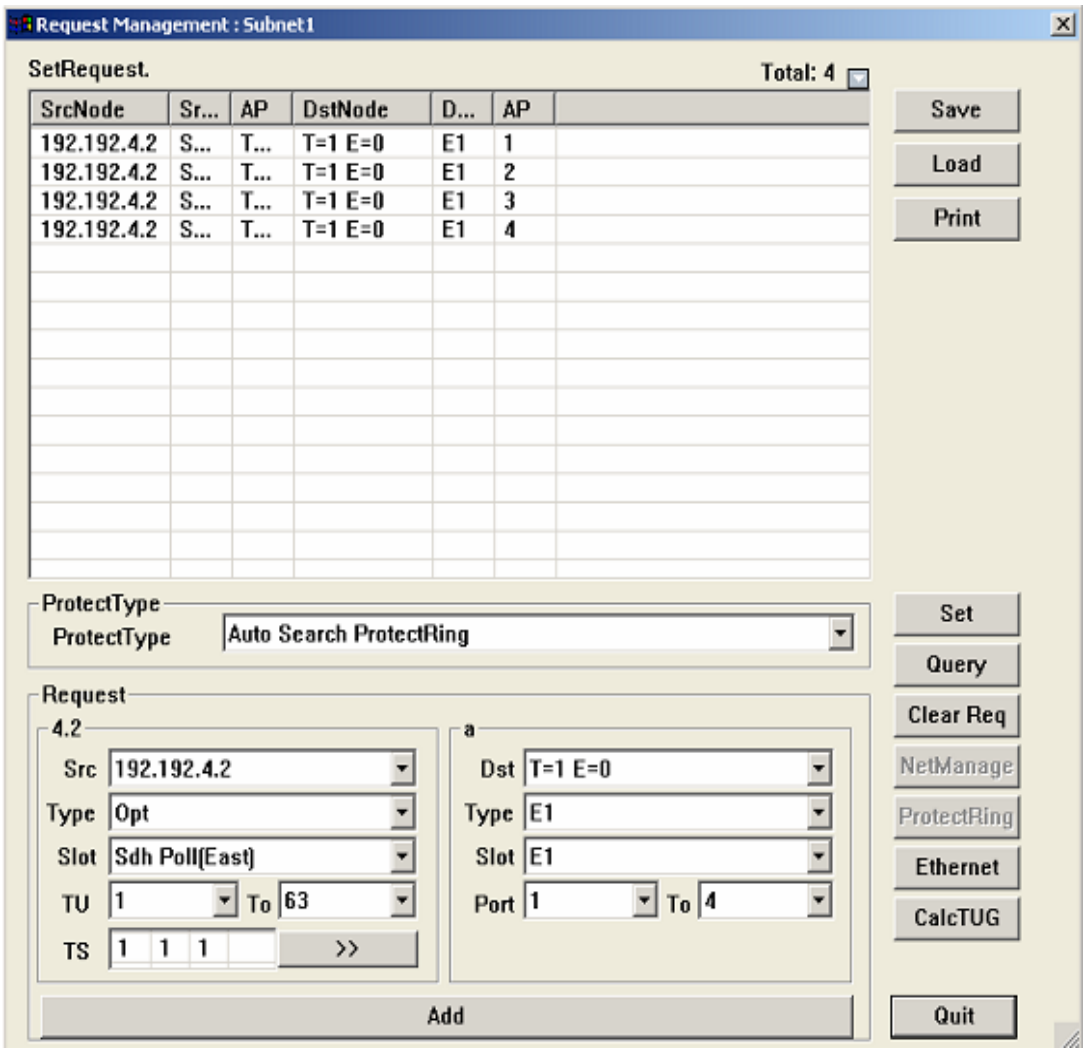


Fig. 5-7 Channel Allocation Command Window

6. 🕮 Specifications

6.1 Standards

H9MO-LMX/LM confirms to the standards listed in table6-1.

Table 6-1 Related Standards

Item		Standard
	STM-1 Optical	G.707, G.957
	STM-1 Electrical	G.707,G.703

	E1	G.703
	Data --- Ethernet	IEEE 802.3，100Base-Tx
Timing	2Mbit/s 2MHz	G.823
	SDH	G.813, G.825
Network Topology		G.783, G.803 G.805 G.958
Network Management		G.744, G.784 ,G.831, Q.811, Q.812, M.3100, M.3000
Protection		G.841, G.842

6.2 Basic Features

6.2.1 H9MO-LMX(Aggregation Device)

TUPP and Cross-connect embedded, 382×382 TU-12 cross-connetct capability;

NIU: SDH interface supported; STM-1 optical interface or electrical interface, support 1+1 protection;

LIU: 16 SDH tributaries (one tributary supports up to 16 E1's and line speed 100 Base-Tx).

6.2.2 H9MO-LM(CPE Device)

SDH Mapping：

E1 mapping---- E1-1：TU-12-1 (1,1,1)；

E1-2：TU-12-2 (2,1,1)；

E1-3：TU-12-3 (3,1,1)；

E1-4：TU-12-4(1,2,1)。

Ethernet Mapping----TU-12-5~TU-12-63 (2,2,1)~(3,7,3)。

E1 Interfaces：

ITU-T G.703，

Bit rate：2048kbit/s ±50ppm，HDB3，75Ω BNC or 1.0/2.3

6.3 SDH Interface

6.3.1 SDH Fiber Optic Interface

Bit Rate： 155520kbit/s (STM-1，G.957, framing G.707)

Line Code： Scrambled NRZ

6.3.2 SDH Coaxial Interface

Bit Rate: 155520kbit/s ±20ppm

Line Code： CMI

6.4 Timing

LMX：

Line clock

Internal oscillation

External clock input

Two 2048kbit/s or 2048 kHz clock, 75Ω

External clock output

One 2048kbit/s or 2048 kHz clock, 75Ω

LM： Line clock or internal oscillation

6.5 Ethernet

10/100Base-Tx Ethernet Interface: IEEE 802.3

10M/100M Auto Negotiation

Half/Full Duplex Auto Negotiation

HP auto-MDIX

802.1Q MAC (up to 1536 byte MAC packet supported)

1K MAC Address Table

64K Byte Packet Buffer Size。

Bandwidth: 1～100 Mbit/s (n 1Mbit/s increment)

LMX: 16 *100Base-TxEthernet Interface (LM: One 100Base-Tx Interface)

6.6 Management Interface

LMX：

Q Interface (Ethernet Interface)：RJ45, SNMP protocol, 10Base-T Ethernet MDI

F Interface: CONSOLE port

Standard: RS232

Connector: DB9F

Pin Definition: 2 Rx; 3 Tx; 5 GND

Port Setting: 9600, 8, N, 1

LM：

RS485 Interface

Default Band Rate: 2400;

1200, 1800, 2400, 4800, 9600, 19200, 38400 selectable

TABS protocol

Port Setting: 8, 1, Odd parity

6.7 Orderwire Telephone

LMX: RJ11 connector, DTMF.

LM: 4P4C handset

6.8 Power

Voltage: -48V (-38V～-62V) or ~220V (176V ~ 260V, LM only)

Power Consumption: LMX ≤ 100W (full system)

LM ≤ 8W

6.9 Environment

Temperature: 5℃ ～ 45℃

Humidity: ≤ 90 % (non-condensing)

6.10 Dimensions

LMX(mm): 436×310×250

LM(mm): 440 × 44 × 138

6.11 Weight

LMX(kg): 13

LM(kg): 2

7. Options

7.1 Option Codes

Options are available for LM and cards on LMX. Options are represented by option codes following a slash '/' at the end of product model. Default configuration is used if an option is not specified.

Option type	Code	Description	Default	Note
Power supply	8	48V DC	AC220V	LMX 48V only
	4	24V DC		CPE only
	E	DC48 or AC220 dual mode		CPE only
	D	DC48 and AC220 dual mode		CPE only
Fiber Interface	F	FC socket	SC socket	CPE, only, S,L,5 not supported
	S	Single fiber	Dual fiber	
	P	1+1 protection	No protection	
	L	Long reach	Short reach	
	5	1550nm wavelength	1310nm	
E1 interface	T	120Ω	75Ω	Not available yet

Example:

H9MO-LM/SL5E denotes a CPE unit with single fiber, 1550nm transmission wavelength, 50km reach, DC48V or AC220V power supply.

7.2 Optical Module Selection

Option codes	Single/Dual fiber	Reach (km)	Wave length T/R (nm)	Note
	D	<40	1310/1310	default
L	D	<60	1310/1310	
L5	D	<100	1550/1550	
S	S	<30	1310/1550	Paired in each link
S5	S		1550/1310	
SL	S	<50	1310/1550	Paired in each link
SL5	S		1550/1310	

Description:

1. All modules operate at 155,520 kbps line rate, with SC connectors.
2. H10Mo-120+ and H10MO-120B are the simplified versions of H9MO-LM, specifically for point-to-point links. H10MO-120+ supports only 4xE1 interfaces, while the H10MO-120B supports full speed 100Base-T interface in addition to the 4xE1.
3. The loop length figures are conservative, assuming 0.4dB/km@1310 and

0.25dB/km@1550, with 6 to 8 dB margins.

4. The option codes denote the optional choices. In addition to the codes listed in the above table, there are other options available.